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WATER POLLUTION CONTROL RESEARCH -
SOUTH CENTRAL REGION

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Robert S. Kerr Water Research Center
Ada, Oklahoma

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The Robert S. Kerr Water Research Center located at Ada, Oklahoma, is the focal point for research within the South Central Region of the Federal Water Pollution Control Administration, U. S. Department of the Interior. The 1961 Amendment to the Federal Water Pollution Control Act provided for the establishment of field laboratories to serve various regions of the United States. These facilities were to conduct research, investigations, experiments, field demonstrations and studies, and training relating to the prevention and control of water pollution. Ada, Oklahoma, was subsequently selected as the site of the facility to serve the Southwestern area; and the Congress, by resolution in 1964, named it the Robert S. Kerr Water Research Center after the late Senator from Oklahoma.

At the present time, five such regional laboratories are in operation. Additional laboratories have been authorized and will be constructed in the

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The regions served by these laboratories are defined by river basins. The river basins served by the Robert S. Kerr Water Research Center consist of the Rio Grande, Arkansas-White-Red, Lower Mississippi, and Western Gulf River Basins. Included in this area are all of the states of Arkansas, Louisiana, Texas, and Oklahoma; and parts of New Mexico, Colorado, Kansas, Missouri, Kentucky, Tennessee, and Mississippi.

The research center, which has been occupied since February 1960, is a three-story building of contemporary design located three miles south of Ada, Oklahoma. It contains 50,000 square feet of laboratory, office, and storage space. Many features included in the building reflect the latest thoughts in design and construction for this type of facility. In addition to the main building, the Center also has a 10-acre auxiliary field site located adjacent to the Ada Sewage Treatment Plant. This site is being developed for pilot plant studies and other activities requiring large open areas.

At the present time, the Center has a permanent staff of about 90. Approximately one-half of these are professional scientific and engineering personnel; the remainder are technical and administrative support personnel. The professional staff includes a variety of scientific and technical disciplines such as chemists, biologists, bacteriologists, soil scientists, geologists, statisticians, chemical engineers, civil engineers, and sanitary engineers. When fully staffed, the Center is expected to have about 150 employees.

The name of the Center--Robert S. Kerr Water Research Center--implies that the mission of the Center is only research. While research is a major activity, two other programs are conducted. These are training and technical services.

The Training Program conducts courses in a variety of subject areas related to water pollution control. The function of the program is to provide the

specialized technical training necessary to shorten the gap between the development of new technologies in the field of water pollution control and their application, by professional and ancillary personnel, to existing pollution problems. To fulfill this function, intensive short-term courses, usually of an advanced nature, are conducted by the training staff to meet the needs of the region. Recognized authorities from government agencies, universities, and industries are used to supplement the permanent training staff by serving as lecturers and consultants.

Training courses conducted by the Center are open to any qualified person in the region who has responsibility for water pollution control activities. This includes personnel from municipalities, States, other Federal agencies, universities, and industries.

A major function of the Technical Services Program is to provide technical assistance upon request to States, municipalities, other Federal agencies, industries, and individuals on specific water pollution problems. In these activities, the technical services personnel work in cooperation with the State water pollution control agency involved by supplementing their staff or by furnishing capabilities which are not otherwise available to them. Some projects of this nature may require only a few days, while others may extend over several months or years. During these assignments, the technical services people may go into the field to consult, advise, and provide the necessary expertise. They may also supplement the otherwise available equipment and manpower as needed.

In addition to these types of projects, technical services personnel conduct projects of a continuing nature which are of general interest but not necessarily the result of a specific request.

Another function of the Technical Services Program is pollution surveillance and basic data collection. This is a continuing program of collecting, analyzing, and cataloging water quality data from the water resources of the region. This information is of tremendous value as base line data for future studies or as raw data for research or other activities. The Pollution Surveillance Program provides a means whereby pollution abatement activities can be evaluated as to their effectiveness in controlling pollution and enhancing the quality of the region's water resources.

The research activities at the Center are conducted by three separate research programs--each having its own areas of responsibility. These programs are Treatment and Control Research, Ground Water Research, and Water Quality Control Research. The projects conducted by these programs are directed to the solution of specific problems--or what is commonly called applied research. This is not to imply that the programs are not involved in basic or theoretical research problems. Some of our projects are of this type. But when we do this type of research, it is a part of a problem-solving project which is necessary for the successful completion of that project. With the multitude of water pollution problems that need solving, we do not feel that we can afford the luxury of research just for research sake, or to satisfy the curiosity of an individual researcher.

Unlike the other programs at the Center, the research programs are not strictly oriented to the region. The programs have a responsibility for doing research which will lead to the solution of problems in the South Central Region; but they also have responsibility for conducting research which will have nationwide application.

To carry out this twofold mission, the various regional laboratories are assigned certain areas of national research responsibility. This is to avoid duplication of effort at the different laboratories, and to also insure that no important area of research is neglected. Each laboratory is to become the "Center of Excellence" for the Federal Water Pollution Control Administration in its assigned areas of research. The combined efforts of the various laboratories constitute the national research program of the Administration. In this manner the research programs at the Center are nationally oriented.

In assigning areas of research to the various laboratories, consideration is given to the problems that are important to their particular region, but not necessarily unique to that region. In the case of the Robert S. Kerr Water Research Center, our assigned responsibilities include such areas as the effect of impoundments on water quality, animal feed lot waste problems, oil production and refinery wastes, irrigation return flows, salt water intrusion into freshwater aquifers and other ground water problems. All of these and others are problems of concern to the South Central Region. In this sense, our research programs have regional significance.

A major responsibility of the Treatment and Control Research Program is the preparation of state-of-the-art documents in various water pollution problem areas. These documents define the problem, catalog the present state of knowledge concerning the problem and its control, identify gaps in technology, and indicate research needs. The Treatment and Control Program is also responsible for applying new technology on a full scale to a real situation to demonstrate its applicability and effectiveness. Areas which have been assigned to this program are: animal feed lot waste problems, pollution emanating from petroleum production and refining, chemical wastes, meat-processing and packinghouse wastes, and irrigation return flow problems.

The Ground Water Research Program has responsibility for all aspects of subsurface pollution. This program investigates problems associated with aquifer recharge; the underground disposal of wastes; and research into the fate of pollutants in ground waters.

The Water Quality Control Research Program carries out research on many different problems, related only in that their solutions depend on other than conventional treatment methods; for example, the control of water quality by physical means such as in-stream aeration techniques, reservoir destratification devices, and stream flow augmentation. Also included is research on control of pollution from natural sources, such as the salt deposits in the Red River Basin; in-plant control of industrial wastes; reduction of pollution by product modification; and the use of soils for the disposal and treatment of wastes.

Having given an overall view of the Center and its various program responsibilities, let me briefly discuss some of the individual research projects which have been conducted.

In cooperation with the U. S. Corps of Engineers, we have conducted research to determine the effectiveness of an imposed hydrostatic head to curb salt pollution from a natural spring. In 1963 the Corps constructed a dike around Estelline Spring, in Hall County, Texas, imposing a hydrostatic head to stop flow from the spring. It had been determined that this spring was a major contributor of salt pollution to the Red River. During the years following the construction, this control measure appeared to be effective, but the absence of irrefutable data caused considerable speculation, and skepticism in some quarters, as to its effectiveness. During this past year, the Ground Water Program at the Center undertook a study to establish the effectiveness of the project. Following a thorough reconnaissance of the area and the selection of appropriate sampling and measuring locations, 18 curies of

tritiated water were placed in the spring and thoroughly mixed. Samples were taken from the spring and other sampling points in the area for a period of 17 weeks and counted for radioactivity. The results of this work showed that the spring was leaking at the rate of 1 cfs (over 600,000 gpd). It was further established that at least part of the leakage was going into the nearest stream, a tributary of Red River, about 4,000 feet from the spring.

In recent years, the stagnation of water at lower depths in impoundments, due to the natural processes of thermal stratification, has become a prime concern and a cause of concentrated effort for remedial measures. Stratification greatly reduces the potential beneficial uses of the lower level waters in impoundments for municipal and industrial water supplies and causes detrimental downstream effects below impoundments during summer power releases. Dissolved oxygen concentrations decrease in the lower layers due to stratification. Fish habitat and production of fish-food organisms are limited in the oxygen-depleted layers at a critical time when most of their annual growth occurs.

During the past two summers, the Water Quality Control Research Program has conducted research on artificial destratification. This work has been conducted on Eufaula Reservoir, a very large impoundment in eastern Oklahoma, using a compressed air system. The primary objective was to develop techniques for destratifying large reservoir waters, utilizing air diffuser systems, and to develop design criteria to the extent that the most economical size and arrangement of systems can be designed for reservoirs of different characteristics.

The system studied during the summer of 1967 was effective in aerating 65,000 acre-feet of water in the central pool of Eufaula Reservoir. The effects of the aeration system were measurable a distance of 2.5 miles from the point of aeration. The most significant result of the 1968 work was the increased dissolved oxygen in power releases. Dissolved oxygen in these releases was

increased from about 3 mg/l to a range of 4 to 5.5 mg/l, depending on the volume of releases.

A problem of almost universal concern is the excessive fertilization of lakes and streams with nitrogen and phosphorus. The result of this over-fertilization is proliferation of algae and other aquatic vegetation, which results in a general degradation of water quality. Major sources of nitrogen and phosphorus are domestic and industrial wastewaters. As a method of removing nitrates and phosphates from these wastes, research is being conducted at the Robert S. Kerr Water Research Center on nutrient removal utilizing hydroponic cultures. The system under study consists of a series of gravel-filled tanks in which various forage grasses are grown using the nutrients from a wastewater on a continuous flow basis. No soil is used in the tanks and the only purpose of the gravel is to support the root system of the plants. Two grasses are being used at the present time--a Kentucky fescue and a perennial rye. Variables being studied include flow rate (detention time), grass species, and the need for supplemental mineral or nutrient addition. Results to date indicate that this type of system will remove 80 to 90 percent of the nitrates but is not effective in removing phosphates. Control tanks containing gravel only have shown an average nitrate removal of 40 percent. The removal attributable to the growing grasses is therefore 40 to 50 percent.

The pollution of ground water with brines originating from oil production is a serious problem in the oil producing states of our Nation. A current project in the Ground Water Program deals with the reclamation of these polluted aquifers by selective pumping. Principal cause of this contamination is related to the disposal of oil field brines into unlined pits and then seepage of these brines into the ground water body.

An intensive field experiment is under way to develop a method for alleviating ground water contamination and controlling the spreading of contaminants in underground reservoirs. Methods are to be developed for predicting rates at which concentrations of contaminants can be expected to decrease in cleanup programs. This contaminant reduction rate will be developed as a function of geometry, concentration, and pumping rate. Pumping is programmed in such a manner that the contaminated water is removed and any further spread of the contaminant is prevented. Water pumped in this manner could be used by oil companies for secondary recovery of oil. This beneficial use of the contaminated water would mean a double benefit from this approach.

For many years, various types of wastes have been treated or disposed of by application to soil systems. One of the most recent developments in this regard is the sometime-called "living filter" or "grass filter." In this system the waste is applied to the land by spray irrigation and allowed to run off. Unlike other soil systems, percolation of the applied waste through the soil is not the purification mechanism, but the passage of the water overland through the vegetative and litter cover is the means of purification.

Several such systems have been put into operation in recent years treating different wastes. While these systems, in most cases, do an excellent job in reducing biochemical oxygen demand, very little is known of their ability to remove other waste constituents such as nitrates and phosphates. Also, these systems do not have a long history of operation; therefore, the long-term effects of the waste application on the soil and crop system are not known.

A current project of the Center seeks to learn more about the operation of these systems. This research project is studying the operation of a 500-acre system which receives approximately 3 million gallons of cannery wastes

per day. Four small watersheds within the system are instrumented and sampled regularly. Some of the questions we hope this project will answer are: What is the removal efficiency with regard to nutrients (nitrogen and phosphorus)? How does the treatment efficiency vary with a wide range of loading and runoff conditions? How does the soil moisture profile vary with loading? What is the effect of a wide range in pH and soil and plants?

Increasing demands on the water resources of the High Plains area of West Texas and Eastern New Mexico have given rise to the very real possibility of storing water underground. This would be accomplished by recharging the Ogallala Aquifer--the area's major source of water. Within this area, thousands of acre-feet of surface runoff are collected each year in natural basins called playas. To prevent extensive losses by evaporation, this water could be injected in the Ogallala Aquifer. There is considerable concern, however, that artificial recharge practices may contaminate the ground water aquifer by introducing undesirable substances with the recharge water. Pesticides and nitrates are of particular importance because of their extensive use in the agricultural practices of the region.

The Ground Water Research Program recently conducted a project in cooperation with the U. S. Department of Agriculture to determine: (1) the distance and manner in which DDT and nitrate move from a well that is being recharged; (2) the degree to which the aquifer will adsorb DDT and nitrate; (3) the manner in which DDT and nitrate are released from an aquifer by pumping a well which has been recharged for a specific time with water containing measured concentrations of these substances; and (4) to perform these tests under conditions where recharge rates, discharge rates, water-level fluctuations, and the physical and hydraulic characteristics of the aquifer are described and recorded sufficiently so as to extend results of this project to other ground water situations.

The three most important points resulting from this study were:

(1) When present, nitrate pollution of the Ogallala is probably of more immediate concern than DDT because of the nitrate's ability to move through the aquifer. (2) A well used for domestic purposes should not be recharged with water in which DDT is suspected because of the possible release of DDT contaminated aquifer material into water subsequently pumped from the well. (3) Considerable caution must be used in extending this work to other pesticides because of the myriad of solubilities and the obviously varied adsorption characteristics encountered.

It has not been my intention to discuss all the research projects currently conducted by the Robert S. Kerr Water Research Center. Neither have I intended to go into any great detail about those projects I have discussed. From this brief discussion, I hope you have gained some useful knowledge of some of the water pollution problems of the South Central Region and the work we are doing at the Robert S. Kerr Water Research Center toward solving them.